GEOLOGIC SETTING OF EAST ANTELOPE BASIN, WITH EMPHASIS ON FISSURING ON ROGERS LAKE, EDWARDS AIR FORCE BASE, MOJAVE DESERT, CALIFORNIA

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In late January of 1991, a large earth fissure formed on the playa surface at the southeast end of Rogers Lake at Edwards Air Force Base (see Blodgett abstract for additional discussion of land-surface deformation of Rogers Lake). Much insight was gained regarding the origin of the fissure through the integration of information obtained from recent regional geologic, geophysical, and hydrologic studies. Pertinent questions are whether the fissure is tectonic or hydrologic in origin and whether future occurrences are likely or predictable. In addition to addressing these questions, recent studies (Dixon and Ward, 1994a, b; Ward and Dixon, 1994a, b) have refined the regional late Tertiary and Quaternary geologic history of the East Antelope Basin, a depocenter for upper Tertiary, lower Quaternary sediments.

Local rock units in the area include tuffs, lava flows, and sediments of the Tropico Group of Tertiary age, Tertiary fanglomerates, Tertiary intrusive rhyolites and dacites, and deeply weathered Mesozoic granitic rocks. Exposed Quaternary geologic units include sandy alluvium, playa clays, and beach deposits; these are of late Quaternary age and related to pluvial Lake Thompson, the remnants of which form the playas (Rosamond, Buckhorn, and Rogers Lakes).

Mabey (1960) first recognized the East Antelope Basin from a 40-mGal gravity low and suggested that the steep gravity gradients may be fault controlled. The gravity signature suggests that this northeast-trending basin (fig. 1) is deepest just southwest of Rosamond Lake and becomes shallow to the northeast. We confirm this as a structural basin not only from gravity data (fig. 2 (Morin and others, 1990), but also from a series of resistivity anomalies (Zohdy and Bisdorf, 1990; 1991), subtle surface escarpments, alignment of historical springs, now dry, which trend N30–45° E, and steep aquifer hydraulic-head gradients. The southeast boundary of the basin is much less apparent, but is definable from field observations and geophysics.

During mid-Quaternary time, a drainage reversal occurred in the region as a result of uplift of the San Gabriel Mountains, and activity along northwest-trending faults blocked the southwest flow of water out of the basin, thus creating Lake Thompson. As the climate became more arid, water sources were depleted; today remnants of Lake Thompson remain in the form of Rosamond, Buckhorn, and Rogers Lakes.

Hydrologically the basin is part of the Lancaster ground-water subbasin and is a source for agricultural, municipal, and industrial ground-water supply in the Antelope Valley area, as well as the primary source of water for Edwards Air Force Base (see Londquist abstract for additional information on the hydrogeology of the Antelope Valley; Londquist and others, 1993).

The fissure on Rogers Lake (fig. 1) is approximately 1–2 m wide, 1.16 km long, and extends to an unknown depth. Although somewhat sinuous, its average trend is within a few degrees of north. Known and inferred faults in the immediate area trend northwest; the extent of the El Mirage Fault mapped by Dibblee (1967) has been reinterpreted to extend beneath south Rogers Lake near the fissure and continue to the northwest, connecting with the Bissell Hills Fault. The fissure occurs near a local gravity low (fig. 2) that defines the northeastern subbasin of the East Antelope Basin, a subbasin we infer to be more than

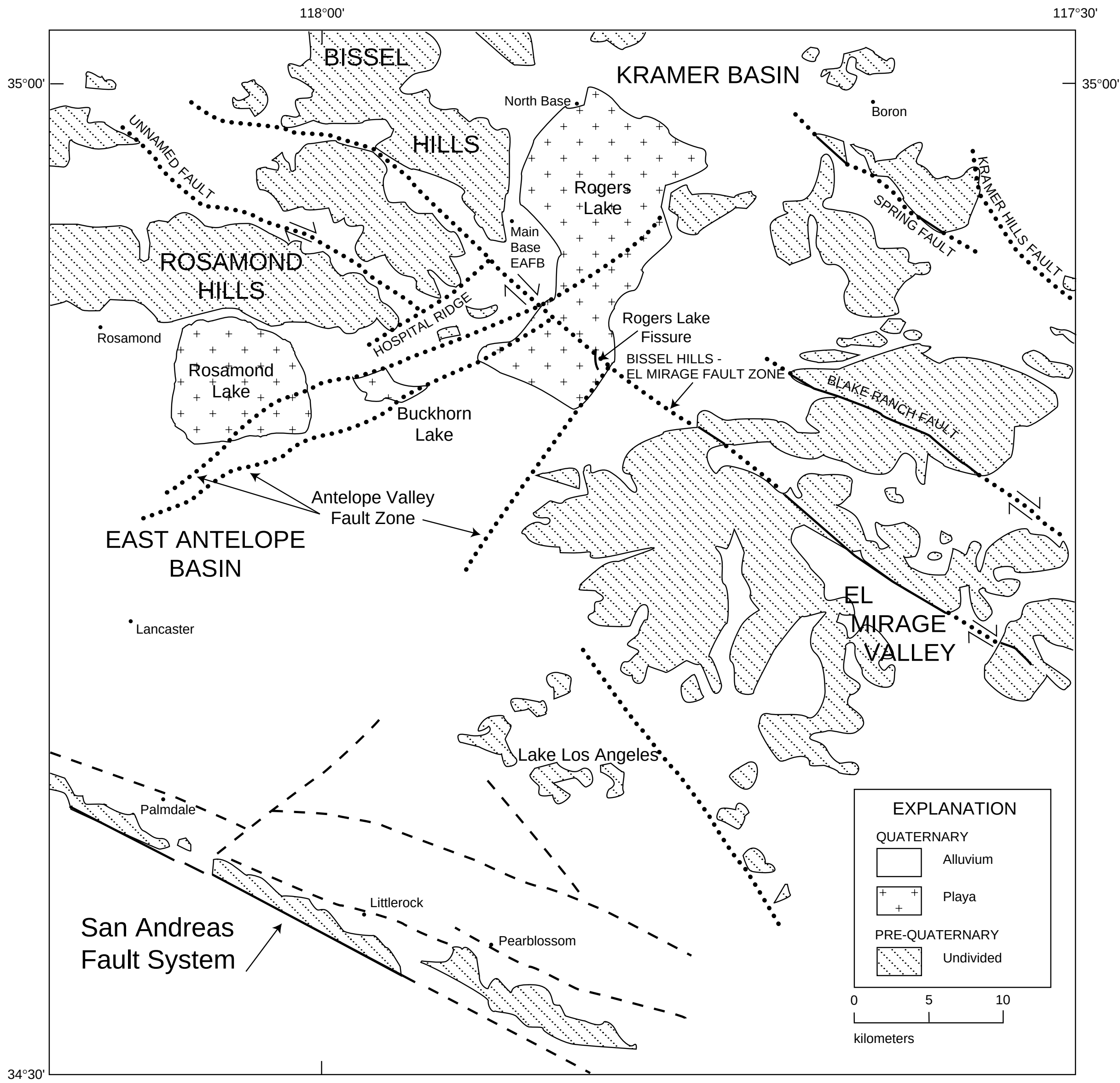

Figure 1. Generalized geologic map of the East Antelope Basin area (modified from Mabey, 1960).

600 m deep. The shape of the basement beneath this sediment-filled subbasin is reflected in the gravity contours that bound the gravity low, which trend at angles of 45° or more from the trend of the fissure. Based on the trends of the major faults in the area, the trends of the gravity contours that define the local subbasin beneath the fissure, and the gravity interpretation that the fissure occurs over a deep part of the basin, argue against a fault-controlled origin of the fissure. More likely, the fissure may have been caused by differential compaction over some nontectonic structure within the sedimentary section, rather than by extensional strain on sediments on a convex-upward basement surface (see Haneberg and Helm abstracts for possible mechanisms of earth-fissure formation).)

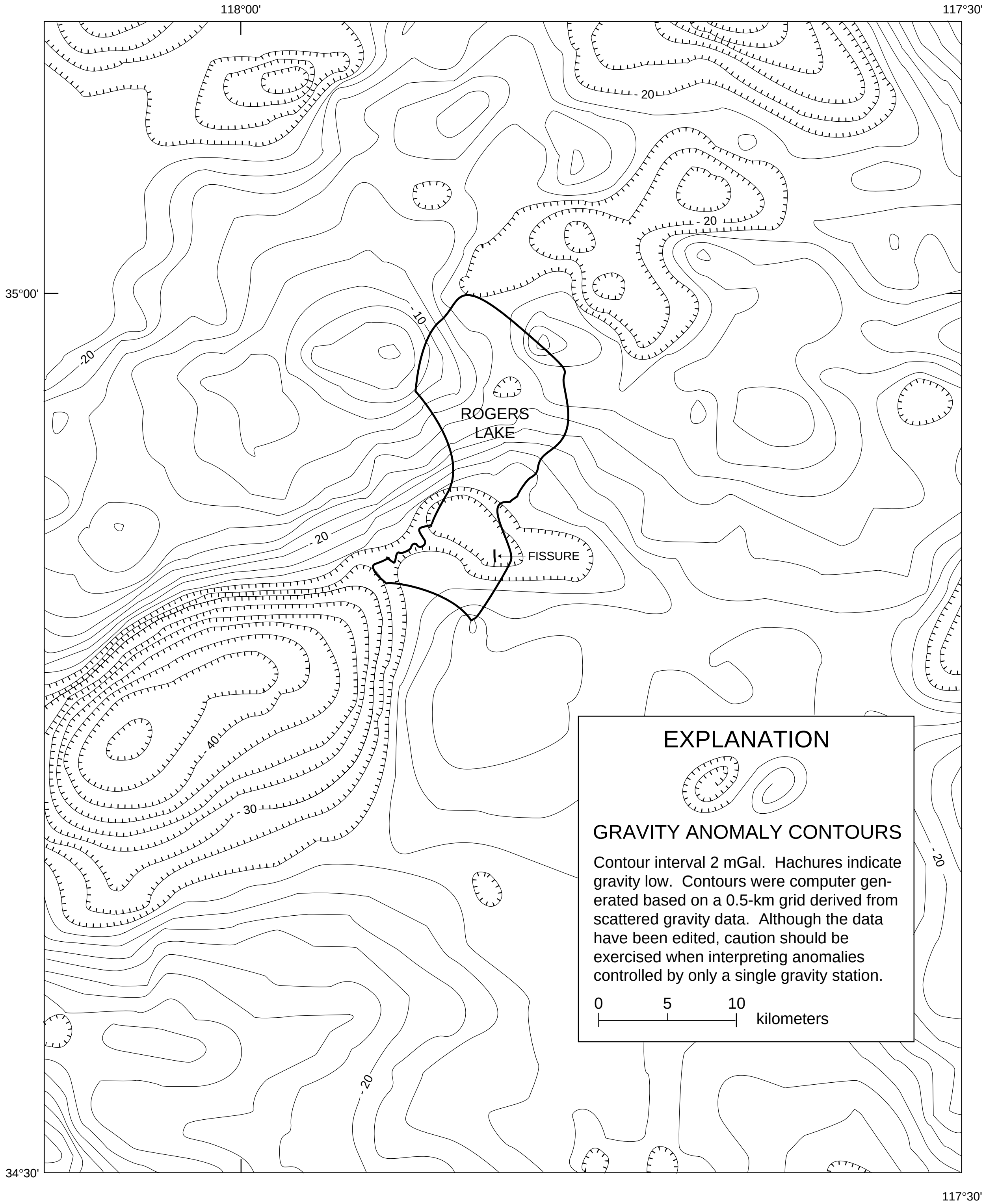

Figure 2. Isostatic residual gravity map of the East Antelope Basin area (Morin and others, 1992).